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REMARKS  
ON THE  
ETIOLOGY OF SUNSTROKE  
(SIRIASIS):  
NOT HEAT FEVER, BUT AN INFECTIOUS  
DISEASE.

By L. WESTENRA SAMBON, M.D.ROME,  
London.

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VERY different conditions have been described by authors under the designation of "sunstroke," and at one time apoplexy was frequently accounted as such. In recent works we find two distinct conditions—heat exhaustion and thermic fever—classed together under the common title of "heat stroke," and most writers describe heat exhaustion as an initial stage of thermic fever. I believe heat exhaustion to be nothing more than syncope and thermic fever, a specific infectious disease which I shall mention in this paper by its oldest name, "siriasis."<sup>1</sup>

SYNCOPE.

When syncope occurs in an overheated atmosphere, it is commonly called heat exhaustion; but this appellation is misleading, because heat is by no means its primary cause. Syncope is really a symptom, not a disease. It occurs in persons of unsound constitution, and especially in those suffering from organic diseases of the heart. The original disease may have been latent, and the sudden prostration, under the stimulus of fatigue, excitement, alcohol, or heat, may be its first manifestation. Numerous necropsies prove this statement.<sup>2</sup> Syncope is common among old stokers—"stokers' collapse"—who are greatly liable to cardiac affections on account of their laborious occupation and of their free indulgence in strong drink. It is very frequent among soldiers, who likewise suffer exceedingly from circulatory disorders, as is well known.<sup>3</sup> Soldiers fall unconscious from syncope at parades or even in barracks, but far more frequently on the line of march, especially when oppressed by tight-fitting clothes and heavy accoutrements, and when obliged to march in "close order" and breathe the foul air which surrounds a close column. Striking examples are on record to show the effects of excessive exertion under unfavourable conditions. On July 4th, 1859, among the

French army at the passage of the Mincio, 2,000 out of a force of 12,500 men were prostrated by syncope, and 26 died (Guyon).<sup>4</sup>

In syncope the skin is moist, pale, and cool; the breathing is easy though hurried; the pulse is small and soft; the temperature is at or below normal; the pupils are dilated; the loss of consciousness is incomplete, and though death may occur, an immediate recovery is the rule.

#### SIRIASIS.

The symptoms and conditions of siriasis are widely different from those of syncope. Siriasis is an acute disease characterised by hyperpyrexia, profound coma, and intense pulmonary congestion. Its mortality is exceedingly high. It has a peculiar geographical distribution; it prevails in the hot season, and occasionally in an epidemic form.

It seems surprising that syncope should have been confounded with siriasis, but it is so and it is all-important to remember this in studying siriasis, because it is the reason of the great confusion which exists in the description of its symptoms and of its *post-mortem* appearances, in the theories advanced to explain its pathology, and in the remedies suggested for its cure.

#### ETIOLOGY.

Siriasis is universally considered as the most obvious effect of exposure to excessive heat, but opinion varies greatly as to the way in which elevated temperature acts in producing the peculiar symptoms of the disease.

Some authors attribute siriasis to a gradual heating of the blood to a degree incompatible with the maintenance of nervous function. Others believe that heat paralyses the centre or centres which are supposed to regulate the disposition of the bodily heat, and thus causes the hyperpyrexia and other symptoms of the disease. This paralysis, according to some, is believed to cause a greater heat production. According to others, it causes retention of heat.

Little considered siriasis to be the result of pressure exerted upon the cerebro-spinal matter by the heat-expanded cerebro-spinal fluid.

Antonini thought it an acute neurosis of the vasomotor system. Laveran suggested that the cause of the disease might be perhaps paralysis of the ganglia of the heart. Vallin put it down to the coagulation of myosin. Senfleben ascribed the malady to disorganisation of the blood and accumulation of urea. Bauer thought the main factor to be a more or less extended liberation of carbonic acid in a blood already saturated with gas. Smart attributed the symptoms of siriasis to a deficiency in the serosity of the body from long-continued profuse sweating. Baxter and Züber, on the other hand, thought that the great rise in the bodily temperature depended upon interference with heat loss as a result of suppression of cutaneous perspiration.

These explanations, however conflicting, are all based on the preconceived idea that heat is the sole efficient cause of the disease. But, on inquiring as to the effects of temperature on human beings, we find that man maintains an almost constant heat in all climates, and that he can endure very high temperatures without harm.

Multitudinous evidence might be adduced; I will take a few examples at random:

The Chinese expose their closely shaven heads to the hottest sun without ill-effects (Maclean).

The Andamanese, with their black heads generally clean-shaved and no cloth on the head, with the whole cranial surface presented in the most suitable manner for absorbing all the heat that falls on it, remain under a noonday sun within 12 deg. N. lat. of the equator, and never notice the heat (Brander).

At the Gold Coast it is a very common thing to see children secured to their mother's backs with the head exposed to the fierce glare and heat of noonday without suffering in the slightest (Clarke).

And not only natives, but also Europeans, work in many tropical countries almost without regard, and yet they enjoy robust health. In Arizona and South Colorado the ordinary avocations of farm and factory are pursued without inconvenience in temperatures of 118° to 128° F. (Greely).

The tea planters of Assam furnish a remarkable illustration of the safety with which Europeans may expose themselves in the hottest sun. Tea planters are a large class, and their duties require them to be out in the hottest season and at the hottest time of day. Mr. Berry White, who for upwards of twenty years had a large practice among Assam tea planters, never knew of a case of sunstroke in Upper Assam (De Renzy).

It is, indeed, surprising what power the human frame possesses of resisting the effects of high temperature. Many of our workmen, such as metal casters, glass blowers, furnace men, and stokers, are exposed for hours together to far greater heat than ever emanated from a tropical sun, yet they never suffer from siriasis.

In the United Consols mine at Gwennap in Cornwall, the temperature is 125° F. Siriasis has never occurred among its miners; their special disease is tuberculosis.

Stokers on large steam vessels work for as long as four hours at the time in ill-ventilated and dark stokeholes, at temperatures varying from 150° to 180° F., and, although occasionally one may be brought up from the furnace unconscious from syncope, or "stoker's collapse" as it has been called, they never show symptoms of siriasis.

Tillett states that the female assistants in the bakeries of La Rochefoucauld entered the oven at a temperature of 301.6° F. The workmen of Sir F. Chantrey were accustomed to enter a furnace in which his moulds were dried whilst the floor was red hot, and a thermometer in the air stood at 350° F.; and Chabert, the "Fire King," was in the habit of entering an oven the temperature of which was from 400° to 600° F. (Carpenter).

There is doubtless a point of heat upon exposure to which all human life would instantly perish, but no climate is subject to such heat.

Numberless experiments have been made on animals for the purpose of studying the effects of exposure to excessive heat, and we have learnt from them that the animal organism when exposed to intense heat, under special conditions, is liable to death, but the conditions to the action of which the animals experimented upon were subjected, and the results derived from them, differ greatly from those of siriasis.

In several diseases, as in scarlatina, typhus fever, erysipelas, variola, relapsing fever, etc., the heat of the body rises to 104° and 105° F., and often reaches 107° F. or even above this. The high temperature may remain constant for days and sometimes weeks, and yet the heat of the blood will not induce the symptoms characteristic of siriasis.

Formerly the term "fever" was not used to indicate simply an increased bodily temperature, but included the various symptoms found concomitant with pyrexia. Now we know that such symptoms are not due to pyrexia, but to the toxins produced by micro-organisms. A temperature which in one disease would be accompanied by pronounced nervous symptoms, may be found in another disease without any marked disturbance. Thus, while in certain cases of typhoid fever a temperature of 103° is attended with marked delirium, in relapsing fever a temperature of 106° occurs with the mind clear.

Fever is the symptom common to all infections, it is perhaps a means of defence of the constitution against its micro-parasitic assailants.



The theory which attributes siriasis to a paralysis of the heat-regulating centres need hardly be discussed; it is merely an hypothesis based upon another hypothesis because we know nothing about a heat-regulating centre, which is only surmised by physiologists, although some authors have ventured to place it in the median and basal portion of the corpus striatum, and others in the optic thalamus.

That the high temperature of siriasis and other fevers is not due to retention of heat is proved by the fact that under no condition is the mechanism of heat dissipation so wonderfully active as in fever.

Vallin's theory of a sudden rigidity of the left ventricle and diaphragm from the coagulation of myosin cannot be regarded in siriasis as a factor in its symptoms and death. In laboratory experiences mammalian muscle becomes rigid at a temperature of  $113^{\circ}$  F.; but death from siriasis generally occurs at a less degree of bodily heat than is necessary to coagulate the muscular substance, and cases with a temperature of  $115^{\circ}$  F. have recovered (Gannett-Norton).

The idea that siriasis is due to excessive heat is greatly derived from the fact that it occurs during the hottest season of the year, but such an argument is manifestly illogical. Although siriasis be intimately connected with the hot season it exhibits remarkable endemic characters. In one locality it is extremely prevalent, in another it is totally absent, though the region may be quite adjacent and under precisely similar climatic influences. Again, its ravages in the same locality, but in different years, vary immensely and quite irrespective of heat. It is well established that the infectious diseases exhibit a decided preference for certain seasons of the year, and many prevail only during the hot weather.

Colin, and recently De Santi, have considered siriasis as a form of malaria. Long before them Dr. Chevers and other Anglo-Indian surgeons had remarked on the probability of sudden attacks of the disease being caused by "malaria in a concentrated form." The success vaunted by several authors in the treatment of the disease with large doses of quinine seemed to offer further proof of the connection. The idea of malaria being the cause of siriasis probably sprang from the fact that those suffering from malaria are most liable to the disease; or, again, from the fact that pernicious malaria may closely simulate siriasis, but it is untenable because in many regions where malaria is most prevalent siriasis is unknown, and, on the other hand, it is greatly prevalent in places which have no malaria. Moreover, in siriasis, the spleen is not enlarged.

Some physicians have likewise speculated on there being a close analogy between siriasis and cholera. The malignity of the disease, the suddenness of its attack, the correspondence of some symptoms, the condition of the blood, and the occasional occurrence of fluid in the small intestine, similar to the choleraic exudation, led to this supposition (Longmore).

The belief that heat alone could not account for siriasis has often been expressed by those who were able to observe the disease in its habitat. Even the oldest Anglo-Indian surgeons, while admitting heat to be the cause of the disease, thought that there must be something else in the *fons et origo mali*, and frequently in their writings we find men-

tioned as causes of siriasis "sun or heat and something more."

The symptoms of the disease, its relapses, its morbid anatomy, its peculiar geographical distribution, its epidemic outbursts, the conditions of climate and soil under which it prevails, the relative immunity to its attacks afforded by acclimatisation all clearly point to the specific infectious nature of the disease. I know not how I can better prove my statement as by taking these points in succession. and offering a sort of running commentary upon them.

#### SYMPTOMS.

*Onset.*—The onset of siriasis is often sudden. Indeed, there are cases which are so sudden as to exemplify in a marked degree the characteristics of profound toxæmia. The patient falls as if shot, gives a few convulsive gasps, and dies. The same suddenness is witnessed in other infectious diseases, as, for example, cholera, plague, cerebro-spinal fever. This fulminant type occurs with variable frequency in epidemics. More commonly there are premonitory symptoms—headache, nausea, drowsiness, a general feeling of weakness, especially in the lower extremities, frequent desire to micturate. These symptoms may appear hours and days before the dangerous conditions set in. Attributing the disease to solar influence, we should expect it to occur in the hottest hours of the day, instead of which it happens mostly by night. It is a common occurrence in India that the stertorous breathing or the retching of the patient, who is apparently asleep in bed, first attracts the attention of room mates, who arouse him with difficulty. Sometimes the patient starts up suddenly, and attempts to escape, staggering about, and struggling violently if laid hold of, but in a few minutes he drops down unconscious.

*Preliminary Stage.*—Generally patients are seized with severe headache, an alarming sense of general oppression and exhaustion, a difficulty in breathing, and a distressing burning in the eyes associated with vertigo and chromatopsia (surrounding objects appear of uniform colour, usually red, blue, or purple). The skin becomes dry and intensely hot, the patient is pale and excessively thirsty. The pulse is rapid, full, and bounding. The respiration is hurried and oppressed. The temperature rises suddenly to 107°, 108°, and sometimes 110° F.; it may reach 112° or 113°, and even above. Vomiting is very common, and may be a special feature at the outset; purging is, in bad cases, almost always present. The dejecta are watery, colourless, and resemble the "rice-water" stools of cholera. The skin and breath have a peculiar mousy odour which is as distinct and unmistakable as is the odour of typhus fever, small-pox, and other diseases. Very often cramps occur in the calves of the legs or in the muscles of the back. A maculo-papular eruption has been described as occurring occasionally, but there is nothing characteristic about it.

*Comatose Stage.*—When the disease has fairly set in, insensibility follows. At first the patient may be partially roused, but he soon passes into a condition of profound coma. The muscles of the face and upper extremities show convulsive twitchings; sometimes there are general convulsions of the most violent description. Authors have described cases in which muscular rigidity amounted to

opisthotonos so great that the body could be lifted by the head and heels. Frequently, however, from the commencement of the attack to its termination in death, the patient remains absolutely motionless. The reflexes are greatly diminished or abolished. The urine is scanty and often suppressed. It usually contains traces of albumen and a few hyalin and granular casts, with blood corpuscles adherent. The respiration is embarrassed and almost entirely diaphragmatic; the patient grinds his teeth and moans loudly at each expiration. A perfect tornado of râles and rhonchi are heard on auscultation. The face and the whole body become cyanosed from an almost complete arrest of capillary circulation. The eyes are fixed and turned slightly upwards, the conjunctivæ are excessively congested, and the pupils are contracted to mere pin points, and do not react to the light. The heart's action is rapid and irregular. After a time convulsions and vomiting cease, the sphincters relax, and the patient lies motionless in a state of low muttering delirium. The skin retains its burning heat, but becomes clammy; the respiration becomes slower and stertorous, with loud mucous rattling in the trachea. Frothy mucus, occasionally mixed with blood, is ejected, often in large quantity from the mouth or forced up the nostrils with each act of expiration. The heart's action becomes tumultuous, the pulse weaker and weaker, and at length the sufferer dies from asphyxia. In favourable cases the temperature falls, the pupils relax, and the patient regains consciousness. The first favourable change is an increased power of respiration, the pulse then quickly falls in frequency, and there is not uncommonly a discharge of urine, after which sleep follows. Termination is usually abrupt, by crisis, as in typhus or pneumonia, and, although the prostration may be extreme, convalescence is rapid.

*Relapses.*—When this desirable change has taken place, and temperature has returned to normal, the patient is by no means out of danger, because a relapse is not uncommon in siriasis. A relapse is a repetition of the original attack; it usually sets in after complete defervescence, and is a strong proof of the infectious nature of the disease.

#### MORBID ANATOMY.

The chief characteristics after death from siriasis are great congestion of the lungs, peculiar fluidity of the blood, extreme venous engorgement. The temperature of the body at death may be at about 110° F., and falls very slowly, if at all, in the first few hours. There may even be a marked *post-mortem* elevation of temperature, as in cholera, yellow fever, and tetanus. Suggillations form quickly and in quantity over the body. *Post-mortem* rigidity is of short duration, and putrefaction takes place rapidly.

The brain and the cord are anæmic and surrounded by effused serum; the ventricles are often distended with serum. The cerebral sinuses and the large venous trunks in the membranes are generally engorged, while the capillaries are empty or nearly so. There is never any sign of hæmorrhage. The ganglion cells exhibit an acute parenchymatous degeneration in every way similar to that produced by microbial poisons (Ira Van Giessen).

The lungs are in a state of hyperæmia without example in any other disease. Their appearance is striking; they



are almost black in colour. The lung tissue is firmer to the touch; it still crepitates on pressure, though not so distinctly as healthy lung, and blood and serum exude abundantly from incisions made into its substance. The bronchi are filled with a frothy serous fluid.

The heart is dark in colour, the left ventricle is contracted and empty; the right chambers and pulmonary arteries contain a certain amount of dark blood only partly coagulated. While the left ventricle and arteries are empty, the venous engorgement is extreme, the fluid blood being all collected in the venous trunks.

The blood, as in all cases of septic diseases, is invariably fluid, extremely dark in colour, and decidedly acid. The red corpuscles, under the microscope, appear discoloured, crenated, and, instead of forming rouleaux, aggregate together in irregular clumps. There are often evidences of marked leucocytosis.

The mucous membrane of the stomach is swollen, and presents patches of a dark purple colour caused by the congestion of minute vessels. In cases in which diarrhœa has been a special feature the intestinal mucosa is also slightly suffused in patches, and the small intestine contains a turbid exudation similar in appearance to that which was passed in the stools.

The organs present parenchymatous changes such as are associated with all the acute infections. The muscular tissue is brown and fragile. The serous membranes show ecchymoses, and effused serum may be found within the pericardium and pleuræ.

#### GEOGRAPHICAL DISTRIBUTION.

In studying the geographical distribution of siriasis we are seriously handicapped, because other diseases have been mistaken for it and because it has been classed in statistics together with apoplexy and other widely different conditions. Lack of space prevents me from elaborating here a minute sketch of its geographical distribution, but I will trace its salient features, which are striking and important.

Siriasis is a widely spread disease in tropical and sub-tropical regions, but its endemic areas are strictly limited. Like yellow fever, it prevails only in the lowest regions, on coast districts, or in the valleys of great rivers; and its altitudinal range is even more restricted than that of yellow fever.

*America.*—The low regions of the United States between the Atlantic and the Appalachian Mountains is a well-known seat of siriasis. Almost every summer cases occur in the large cities of the coast, but their number varies greatly in consecutive years. Siriasis is also prevalent in the valley of the Mississippi and on the coast of the Mexican Gulf, but it is unknown in the Western States and in Central America, over the whole extent of the Cordilleran Plateau. In South America, siriasis has been observed in the valley of the Amazon, in the States of La Plata, and on the South Atlantic coast, but information is scanty.

*Europe.*—Siriasis is unknown in Europe. Cases mentioned in England, France, Germany, and Italy as "sunstroke" are always mistaken cases of syncope, delirium tremens, cerebral hæmorrhage, tuberculous meningitis, or cerebro-spinal fever.

*Africa.*—It is very frequent in the valley of the Nile and on the shores of the Red Sea. It occurs also in Algeria. Borius mentioned "insolation" in Senegal, but his cases were evidently cases of malaria. His patients did not show symptoms peculiar to siriasis, but had rigors, profuse sweatings, and renewed paroxysms within twenty-four or forty-eight hours. Barclay mentioned cases of "sunstroke" in South Africa, on the Fish River, but they were cases of syncope.

*Asia*.—Siriasis is found in Syria. An epidemic of it broke out in Jerusalem in 1868. It is common on the shores of the Persian Gulf. In India it prevails in the great low plains drained by the Indus and the Ganges, but it is unknown on the plateau which forms the southern part of the Peninsula. Siriasis is said to be prevalent in Lower Burma, in Tonquin, and along the southern and south-eastern coasts of China.

*Australia*.—It is found in the Riverina along the River Murray and on the coast of Queensland. It is said to occur also in the plains of Sydney.

#### OCCURRENCES AT SEA.

Siriasis is characteristically a land affection. It is extremely frequent in the months of August and September on board ships steaming through the Red Sea or stationed at places on its coasts. Indeed, 90 per cent. of all cases in the British navy occur in the Red Sea (Lloyd), the disease having been contracted while coaling or stopping along its coasts. In the Persian Gulf cases are also of frequent occurrence. H.M.S. *Liverpool*, during her passage from Muscat to Bushire in the summer of 1831 lost 3 officers and 30 men in one day (Wellsted).

Crews of ships in harbours have been at times severely attacked. The French warship *Duquesne*, while at Rio Janeiro, had 100 cases out of a crew of 600, and most cases occurred at night.

Very few cases have been recorded as having taken place on the open sea, and although the necessary period of incubation might account for them, they were mostly only cases of syncope, which is not uncommon at sea, especially among stokers, cooks, and stewards.

#### EPIDEMICS.

The number of cases of siriasis varies greatly in consecutive years, quite irrespective of heat; and at times, under favourable conditions, siriasis has prevailed in an epidemic form.

In June and July, 1872, it raged in the middle Atlantic States of North America, and nearly 1,000 cases occurred in New York city. A most remarkable outbreak occurred in 1892 in the central States, within certain geographical limits east of the Mississippi.

#### IMMUNITY.

New arrivals in the regions where siriasis prevails are far more liable to be attacked than natives or old residents. This fact has been repeatedly observed both in India and America.

In the march from Nuddea to Berhampore of Her Majesty's 13th Light Infantry, though it was chiefly conducted during the night, the effects were fatal in a remarkable degree to Europeans, while none of the natives were taken ill. The soldiers consisted of older men who had recently returned from the first Rangoon campaigns, and recruits but recently arrived from England. Both the sickness and the mortality were principally confined to the recruits.

But if natives and old residents are much less susceptible to the disease than strangers, they do not enjoy an immunity.

Perrier mentions the terrible disasters from siriasis among the fugitive Arabs in Algiers at the time of the French occupation. He says: "La fuite de la Zmala d'Abd-el-Kader en 1843 a fournie un exemple: 'à chaque gâte,' dirent les Arabes, 'nous laissions un petit cimetière.'"

Although natives are at times severely taxed, yet the enormous difference in the numbers of new arrivals attacked shows beyond doubt that acclimatisation reduces the susceptibility to siriasis as it does to yellow fever and enteric fever.

#### METEOROLOGICAL CONDITIONS.

*Heat*.—The prevalence of siriasis, like that of enteric fever, cholera infantum, and other infectious diseases is closely connected with summer. But it is important to remark that this



connection with the hottest season does not necessarily imply a connection with the highest temperature. Indeed, it has often been observed that the hottest days and the hottest years are not those in which the disease especially occurs, and again it is not always found in the warmest regions. In its Indian habitat, siriasis is usually expected to appear when for several days in succession the temperature has reached 96° F. and the air is still. But it has prevailed at much lower temperatures, while it is unknown in places with temperatures of 120° to 130° F. In the United States it becomes imminent during the summer in temperatures varying between 74° and 90° F. In August, 1896, it was noticed that siriasis prevailed in Boston when the average temperature of the day reached 82°, but in New Orleans, with the same temperature, that year there was no siriasis (Phillips).

*Moisture.*—Opinion varies considerably on the importance of moisture as a factor in the prevalence of siriasis. Some authors hold that much atmospheric moisture is essential to its occurrence, because of the fact that a damp atmosphere diminishes tolerance to high temperatures, but this is an *a priori* argument, founded on the supposition that heat is the primary cause of siriasis, and is contrary to all experience. In India siriasis is mostly prevalent in May and the first part of June when the atmosphere is hot and dry. It ceases during the rains, and appears again, though to a less extent, in September and October, when the air is loaded with moisture. In North America, in 1896, the disease occurred in the valley of the Mississippi, with a relative humidity above the average, but on the Atlantic coast with a relative humidity decidedly below the average. And, although the absolute humidity was greatest during the maximum of siriasis, yet its variations did not appear to influence the number of cases. The amount of moisture in the subsoil is of much more importance than the hygrometric condition of the atmosphere, and we know for certain that the disease always ceases after a heavy rainfall, even though the temperature return to its previous height.

*Wind.*—Many facts are on record which seem to indicate that the disease may be carried by the wind, and the Hindus call it "*Loo-marna*," which means hot-wind stroke.

Brunel writes that the malady is prevalent in the River Plate States even in spring, when the hot and damp north or north-east winds blow from the plains of Brazil. Lindesays says that siriasis appeared in Chunar, Central India, in 1833, when a burning hot wind set in suddenly from the west after a long spell of east winds, and that it ceased when the wind blew again from the east. Mouat observed it among British troops on the march from Calcutta to Berhampore, on the sudden setting in of an excessively hot wind; and likewise McGregor, in 1840, saw it in Kampi appear and disappear with the wind.

#### PREDISPOSING CAUSES.

*Age.*—Siriasis attacks all ages. Children are quite as susceptible to it as adults, but the disease has often remained unrecognised, being mistaken for cholera infantum, enteritis, etc. One of the earliest recorded cases was that of the child of the Shunamite woman (2 Kings iv, 18 21). In the outbreaks of 1872 and 1892 in the United States children suffered severely.

*Sex.*—Siriasis, like tetanus, cerebro-spinal fever, and other similar diseases, is far more common in men than women owing to greater exposure. Amongst children, the number of males and females is about equal.

*Occupation.*—Siriasis is not confined to any particular trade or occupation, and certainly it is not more frequent amongst workmen exposed to intense heat. The selection of soldiers as most frequent victims has made the disease a familiar guest in army life.

*Intemperance.*—The question of the previous abuse of alcohol is one about which there is a wide difference of opinion, but there can be no doubt that habitual intemperance lessens the power of resisting disease.

*Unsuitable Clothing and Accoutrements.*—Authors have unanimously pointed to the influence of tight-fitting clothing and heavy accoutrements, which constrict the chest and obstruct circulation, as a most potent cause of sunstroke, but in all instances mentioned we find that syncope was the condition incurred, and not siriasis.

*Over-fatigue.*—Excessive bodily fatigue is generally considered the chief predisposing cause, and several instances are mentioned of regiments which suffered severely from siriasis during long forced marches under oppressive heat, but there are likewise many instances on record when regiments exposed to the very same conditions were entirely free from the disease.

The dreadful march of the 43rd Light Infantry from Jubbulpore to Calpee is mentioned by several authors for the purpose of showing the effects of excessive fatigue under exposure to intense heat. I gather from it very different information. The 43rd Light Infantry had been four months and thirteen days in the field, and had marched 969 miles before a single case of siriasis occurred. The disease set in with the hot land winds; it was most destructive in the ravines of Northern Bundelcund, where the regiment was obliged to encamp for several days. After that, although the march continued and the effects of fatigue augmented, siriasis greatly diminished, and at Banda no cases occurred.

In the American Civil War, when the troops were hurried along at a rapid rate of thirty-five and forty miles a day although many soldiers fell out of the ranks from exhaustion, not a single case of siriasis occurred.

Very frequently regiments have been attacked in barracks. Officers have been struck while riding at a gentle pace in the marching column (Smart).

*Overcrowding.*—It has been frequently noticed in India that siriasis is more prevalent under conditions of overcrowding, defective ventilation, and filth. Of the cases occurring on board ship, the majority are among the third-class passengers on account of their worse accommodation.

*Previous Illness.*—Siriasis may occur in robust and healthy individuals, but again and again it has been observed that it attacks more especially those exhausted by previous infections. Very frequently it supervenes on malarial diseases. In such cases the comatose stage of siriasis appears suddenly without any preliminary indications just as cholera might do, and not as if the former symptoms were merely aggravated (Longmore). In the epidemic at Assouan (1887) patients suffering from enteric fever were attacked (Hunter). Most interesting are the cases which occurred in 1868 on board the Abyssinian hospital ship (Annesley Bay). From May 12th to June 4th 7 cases occurred. One patient was brought in from the camp at Zoulla, but 6 cases happened on board ship in patients convalescing from dysentery and diarrhoea. It is important to note that no cases occurred in the cookhouse, with a temperature of 130° to 150° F., or amongst the firemen in the engine room with a temperature of 130° F., while they took place on the lower-after hospital deck in a temperature of from 82° to 90° F.

*Mode of Infection.*—The specific organism of siriasis is pro-

bably spread in the superficial layers of the soil, like other pathogenic micro-organisms, and may be conveyed to man with dust blown by the wind or thrown up under the tread of a marching column. It is then inhaled into the lungs, or ingested into the alimentary canal, where it produces the deadly toxin which probably, as in cholera, becomes absorbed and sets up the symptoms of the disease.

#### DIAGNOSIS.

Siriasis has marked characteristics, and now that we have a clear sketch of its symptoms it should not be confounded with syncope, alcoholic coma, cerebral hæmorrhage, and epilepsy. But there are two diseases with which it may be easily mistaken: cerebro-spinal fever and pernicious malaria.

*Cerebro-spinal Fever.*—Cerebro-spinal fever may closely simulate siriasis. In cerebro-spinal fever an early, frequent, and important symptom is the painful stiffness of the muscles of the neck; the patient lies with the body rigid and the head drawn back. The pupils may be contracted, but they are usually dilated or unequal. Strabismus is a frequent and important symptom. Herpes is very common. Cerebro-spinal fever begins with a chill which may recur several times in the course of the illness. In some cases the temperature may run as high as  $106^{\circ}$  or  $108^{\circ}$  F., but it usually averages from  $101^{\circ}$  to  $103^{\circ}$  F.; its characteristic in this disease is irregularity. The respirations are often increased in frequency; in the graver conditions breathing becomes embarrassed but not stertorous. Profound coma is exceptional, and delirium is always present at some stage of the disease. Constipation is the rule, and the urinary secretion is normal in quantity notwithstanding the fever. Foudroyant cases may end fatally in a few hours, but ordinary cases last from one to three weeks. Cerebro-spinal fever prevails mostly in temperate regions, and is more frequent during the colder months.

Many of the cases put down to sunstroke in England and France were undoubtedly cases of cerebro-spinal fever; take, for example, the cases described by Donkin<sup>5</sup> in 1888, some of those described by Bullar<sup>6</sup> and Strange<sup>7</sup> in 1868, by Armitage in 1881,<sup>8</sup> those reported by Ducleaux in 1859.<sup>9</sup>

*Pernicious Malaria.*—Manson and others have described a comatose form of malaria which greatly resembles siriasis. I am strongly inclined to believe that many of the cases reported as malaria in China and India were really cases of siriasis, but undoubtedly pernicious malaria may closely simulate this disease, and the diagnosis may be almost impossible, especially when the two conditions are found concomitant in the same patient, as not infrequently occurs. Pernicious malaria never occurs with the first attack, but shows itself in the second or third. Rigors usually precede the paroxysm.

#### CONCLUSION.

I know the title of this paper will startle many, but what I think most surprising is that siriasis should have remained so long in the domain of astrology. I have endeavoured to extricate it from the confusion in which it was enveloped, and I hope I have succeeded in giving a clear and correct sketch of the disease, and of the conditions under which it prevails. To have a correct notion of the etiology of any disease is undoubtedly important, but in the case of siriasis it is especially



so, because this malady has been used as the strongest argument to prove some of the most hypothetical theories on fever, and, in another field, the noxious influence of a tropical climate.

#### NOTES AND REFERENCES.

<sup>1</sup> The ancients called it siriasis because of its prevalence during the hottest season, when Sirius, the dog star, rises and sets with the sun, and they called it siriasis *Aegyptiaca* because they had observed it in the valley of the Nile and on the coasts of the Red Sea. <sup>2</sup> See Kelsch, *Bull. Acad. de Méd.*, Paris, 1895. 3 s., xxxiii, 168-176. <sup>3</sup> In 114 *post-mortem* examinations of soldiers dying at Netley Dr Davidson found 22 cases of atheroma of the aorta, *Army Med. Dept. Repts.*, vol. v, p. 481. Dr. Lawson calculated that aneurysm was eleven times more frequent among soldiers than civilians. On the effect of exertion in war in causing cardiac hypertrophy, see Dr. Fräntzel's paper in *Virchow's Archiv*, Bd. lvii, p. 215. <sup>4</sup> This example has been frequently mentioned by authors, but erroneously, because they say: "The French army lost 2,000 men out of a force of 12 000" thus conveying the idea that 2,000 men died on that day of substroke. <sup>5</sup> *Westminster Hospital Reports*, 1888, iii, 163-169. <sup>6</sup> *BRITISH MEDICAL JOURNAL*, August 22nd, 1868. <sup>7</sup> *Ibid.*, August 20th. <sup>8</sup> *St. Bartholomew's Hospital Reports*, 1881. <sup>9</sup> *Comptes Rendus de l'Acad.*, 1860, i, 543.